103, specifying the information indicating the covered background area information and the information indicating the uncovered background area information, is fed to the separating unit 251, whilst the area information indicating the foreground information and the area information indicating the background area are routed to the switches 252, 254, respectively.

The mixing ratio α supplied from the mixing ratio calculating unit 104 is sent to the separating unit 251.

The separating unit 251 separates the foreground component from the input picture, based on the area information indicating the covered background area information, the area information indicating the uncovered background area information and the mixing ratio α, and supplies the so-separated foreground component to a synthesis unit 253, while separating the background component from the input picture to route the so-separated background component to the synthesis unit 255.

When a pixel corresponding to the foreground is input, the switch 252 is closed, based on the area information indicating the foreground area, to route only the pixels corresponding to the foreground contained in the input picture to the synthesis unit 253.

When a pixel corresponding to the background is input, the switch 254 is closed, based on the area information indicating the background area, to route only the pixel corresponding to the background contained in the input picture to the synthesis

unit 255.

The synthesis unit 253 synthesizes a foreground component picture, based on the component from the separating unit 251, corresponding to the foreground, and on the pixel from the switch 252, corresponding to the foreground, to output the synthesized foreground component picture. Since the foreground area and the mixed area are not overlapped, the synthesis unit 253 applies the processing of logical sum to the component corresponding to the foreground and to the pixel corresponding to the foreground to synthesize the foreground component picture.

In the initializing processing, executed first in the processing for synthesizing the foreground component picture, the synthesis unit 253 stores a picture with all zero pixel values in an internal frame memory to store (overwrite) the foreground component picture in the processing for synthesizing the foreground component picture. Thus, in the pixels corresponding to the background area, in the foreground component picture output by the synthesis unit 253, 0s are stored as pixel values.

The synthesis unit 255 synthesizes the background component picture, based on the components from the separating unit 251 and on the pixels from the switch 254 corresponding to the background, to output the synthesized background component picture. Since the background area and the mixed area are not overlapped, the synthesis unit 255 applies the processing of logical sum to the component corresponding to the background and to the pixel corresponding to the background to synthesize the background component picture.

In the initializing processing, executed first in the processing for synthesizing the background component picture, the synthesis unit 255 stores a picture with all zero pixel values in an internal frame memory to store (overwrite) the background component picture in the processing for synthesizing the background component picture. Thus, in the pixels corresponding to the foreground area, in the background component picture output by the synthesis unit 255, 0s are stored as pixel values.

Fig.49 shows an input picture, fed to the foreground/background separating unit 105, and the foreground component picture and the background component picture, output from the foreground/background separating unit 105.

Fig.49A schematically shows the displayed picture, while Fig.49B diagrammatically shows a model obtained on developing one-line pixels comprised of pixels belonging to the foreground area, pixels belonging to the background area and the pixels in the mixed area, along the time axis.

Referring to Figs.49A and 49B, the background component picture, output from the foreground/background separating unit 105, is comprised of a background component contained in the pixels belonging to the background area and pixels belonging to the mixed area.

Referring to Figs.49A and 49B, the foreground component picture, output from the foreground/background separating unit 105, is comprised of a foreground component contained in the pixels belonging to the foreground area and pixels belonging to the mixed area.

The pixel values of the pixels of the mixed area are separated by the foreground/background separating unit 105 into the background component and the foreground' component. The background component, thus separated, makes up the background component picture along with the pixels belonging to the background area. The foreground component separated makes up the foreground component picture along with the pixels belonging to the foreground area.

In this manner, the pixel values of the pixels of the foreground component picture, associated with the background area, are set to 0, while meaningful pixel values are set in the pixels corresponding to the foreground area and to the pixels corresponding to the mixed area. Similarly, the pixel values of the pixels of the background component picture, associated with the foreground area, are set to 0, while meaningful pixel values are set in the pixels corresponding to the background area and to the pixels corresponding to the mixed area.

The processing executed by the separating unit 251 in separating the foreground and background components from the pixels belonging to the mixed area is explained.

Fig.50 diagrammatically shows a model of a picture showing foreground and background components of two frames including the foreground corresponding to an object moving from left to right in the drawing. In the picture model of Fig.50, the movement quantity v of the foreground is 4, with the number of times of the virtual splitting being 4.

In the frame #n, the leftmost pixel and fourteenth to eighteenth pixels from left are composed only of the background components and belong to the background area. In the frame #n, the second to fourth pixels from left include background and foreground components and belong to the uncovered background area. In the frame #n, the eleventh to thirteenth pixels from left include background and foreground components and belong to the covered background area. In the frame #n, the fifth to tenth pixels from left include only foreground components and belong to the covered foreground area.

In the frame #n+1, the first to fifth pixels and the eighteenth pixel from left are composed only of the background component and belong to the background area. In the frame #n+1, the sixth to eighth pixels from left include background and foreground components and belong to the uncovered background area. In the frame #n+1, the fifteenth to seventeenth pixels from left include background and foreground components and belong to the covered background area. In the frame #n+1, the ninth to fourteenth pixels from left include only foreground components and belong to the covered foreground area.

Fig.51 illustrates the processing for separating the foreground component from the pixels belonging to the covered background area. In Fig.51, $\alpha1$ to $\alpha18$ represent the mixing ratio values associated with respective pixels of the frame #n. In Fig.51, the fifteenth to seventeenth pixels from left belong to the covered background area.

The pixel value C15 which is the fifteenth pixel from left of the frame #n is

represented by the following equation (29):

$$
\begin{aligned}
C15 &= B15/v + F09/v + F08/v + F07/v \\
&= \alpha15 \cdot B15 + F09/v + F08/v + F07/v \\
&= \alpha15 \cdot P15 + F09/v + F08/v + F07/v
\end{aligned}
\quad \cdots (29)
$$

where $\alpha15$ is the mixing ratio of the fifteenth pixel from left of the frame #n and P15 is the pixel value of the fifteenth pixel from left of the frame #n-1.

Based on the equation (29), the sum f15 of the foreground components of the fifteenth pixel of the frame #n is represented by the equation (30):

$$
\begin{aligned}
f15 &= F09/v + F08/v + F07/v \\
&= C15 \cdot \alpha15 \cdot P15
\end{aligned}
\quad \cdots (30).
$$

Similarly, the sum f16 of the foreground components of the sixteenth pixel of the frame #n and the sum first wiring pattern 17 of the foreground components of the seventeenth pixel of the frame #n are represented by the equations (31) and (32):

$$f16 = C16 \cdot \alpha16 \cdot P16 \quad \cdots (31)$$

and

$$f17 = C17 \cdot \alpha17 \cdot P17 \quad \cdots (32)$$

respectively.

In this manner, the foreground components fc, contained in the pixel value C of the pixel belonging to the covered background area, may be calculated by the equation (33):

$$fc = C \cdot \alpha \cdot P \quad \cdots (33).$$

Fig.52 illustrates the processing for separating the foreground components from the pixels belonging to the uncovered background area. In Fig.52, α1 to α18 represent the values of the mixing ratio for respective pixels of the frame #n. In Fig.52, the second to fourth pixels from left belong to the uncovered background area.

The pixel values C02 of the second pixel from left of the frame #n are represented by the equation (34):

$$\begin{aligned} C02 &= B02/v + B02/v + B02/v + F01/v \\ &= \alpha 2 \cdot B02 + F01/v \\ &= \alpha 2 \cdot N02 + F01/v \end{aligned} \quad \cdots (34)$$

where α2 is a mixing ratio of the second pixel from left of the frame #n and N02 is a pixel value of the second pixel from left of the frame #n+1.

Based on the equation (34), the sum f02 of the foreground component of the second pixel from left of the frame #n is represented by the equation (35):

$$\begin{aligned} f02 &= F01/v \\ &= C02 \cdot \alpha 2 \cdot NO2 \end{aligned}$$

$$\cdots (35)$$

Similarly, the sum f03 of the foreground components of the third pixel from left of the frame #n and the sum f04 of the foreground components of the fourth pixel from left of the frame #n are represented by the following equations (36) and (37):

$$f03 = C03 \cdot \alpha 3 \cdot NO3 \qquad \cdots (36)$$

and

$$f04 = C04 \cdot \alpha 4 \cdot NO4 \qquad \cdots (37)$$

respectively.

The foreground component *fu* included in the pixel value C of the pixel belonging to the uncovered background area is calculated by the following equation (38):

$$fu = C \cdot \alpha \cdot N \qquad \cdots (38)$$

where N is a pixel value of a corresponding pixel of the next frame.

In this manner, the separating unit 251 is able to separate the foreground components and the background components from the pixels belonging to the mixed area, based on the information indicating the covered background area and on the information indicating the covered background area, contained in the area information, and on the pixel-based mixing ratio α.

In Fig.53, which is a block diagram showing an illustrative structure of the separating unit 251 adapted for executing the above-described processing, a picture input to the separating unit 251 is input to the frame memory 301, whilst the area information indicating the covered background area and the uncovered background area, and the mixing ratio α, are input to a separating processing block 302.

The frame memory 301 stores the input pictures on the frame basis. If the object of processing is the frame #n, the frame memory 301 stores the frame #n-1, directly previous to the frame #n, frame #n and the frame #n+1 next to the frame #n.

The frame memory 301 routes the corresponding pixels of the frame #n-1, frame #n and the frame #n+1, to a separating processing block 302.

Based on the area information indicating the covered background area information and the uncovered background area information, and on the mixing ratio α, the separating processing block 302 performs calculations, explained with reference to Figs.51 and 52, on the pixel values of the corresponding pixels of the frame #n-1, frame #n and the frame #n+1, supplied from the frame memory 301, to separate the foreground and background components from the pixels belonging to the mixed area of the frame #n to route the separated components to a frame memory 303.

The separating processing block 302 is made up of an uncovered area processor 311, a covered area processor 312, a synthesis unit 313 and a synthesis unit 314.

The uncovered area processor 311 includes a multiplier 321 which multiplies the pixel value of the pixel of the frame #n+1 supplied from the frame memory 301

with the mixing ratio α to route the resulting product to the switch 322, which is closed when the pixel of the frame #n (corresponding to the pixel of the frame #n+1) supplied from the frame memory 301 is in the uncovered background area, to route the pixel value multiplied with the mixing ratio α sent from the multiplier 321 to an operating unit 322 and to the synthesis unit 314. The pixel value of the pixel of the frame #n+1 from the switch 322, multiplied by the mixing ratio α, is equal to the background component of the pixel value of the corresponding pixel of the frame #n..

An operating unit 323 subtracts the background component supplied from the switch 322 from the pixel value of the pixel of the frame #n supplied from the frame memory 301 to find the foreground component. The operating unit 323 routes the foreground component of the pixel of the frame #n, belonging to the uncovered background area, to the synthesis unit 313.

The covered area processor 312 includes a multiplier 331 which multiplies the pixel value of the pixel of the frame #n-1 supplied from the frame memory 301 with the mixing ratio α to route the resulting product to the switch 322, which is closed when the pixel of the frame #n (corresponding to the pixel of the frame #n-1) supplied from the frame memory 301 is in the covered background area, to route the pixel value multiplied with the mixing ratio α sent from the multiplier 331 to an operating unit 333 and to the synthesis unit 314. The pixel value of the pixel of the frame #n-1 from the switch 332, multiplied by the mixing ratio α, is equal to the background component of the pixel value of the corresponding pixel of the frame #n.

An operating unit 333 subtracts the background component supplied from the switch 332 from the pixel value of the pixel of the frame #n supplied from the frame memory 301 to find the foreground component. The operating unit 333 routes the foreground component of the pixel of the frame #n, belonging to the covered background area, to the synthesis unit 313.

The synthesis unit 313 synthesizes the foreground component of the pixel from the operating unit 323, belonging to the uncovered background area, to the foreground component of the pixel belonging to the covered background area, to route the resulting sum to the frame memory 303.

The synthesis unit 314 synthesizes the background component of the pixel from the operating unit 323, belonging to the uncovered background area, to the background component of the pixel from the switch 332 belonging to the covered background area, to route the resulting sum to the frame memory 303.

The frame memory 303 stores the foreground and background components of the pixels of the mixed area of the frame #n, supplied from the separating processing block 302.

The frame memory 303 outputs the stored foreground component of the pixels of the mixed area of the frame #n and the stored background component of the pixels of the mixed area of the frame #n.

By exploiting the mixing ratio α as a characteristic value, the foreground and background components contained in the pixel value can be separated completely from

each other.

The synthesis unit 253 synthesizes the foreground component of the pixels of the mixed area of the frame #n , output by the separating unit 251, and the pixels belonging to the foreground area, to each other, to generate a foreground component picture. The synthesis unit 255 synthesizes the background component of the pixels of the mixed area of the frame #n , output by the separating unit 251, and the pixels belonging to the background area, to each other, to generate a background component picture.

Fig.54 shows an example of a foreground component picture and an example of the background component picture corresponding to the frame #n of Fig.50.

Fig.54A shows an example of the foreground component picture corresponding to the frame #n of Fig.50. The pixel values of the leftmost pixel and the fourteenth pixel from left were composed only of the background component before foreground/ background separation, and hence are equal to 0.

The second to fourth pixels from left belonged to the uncovered background area before foreground/ background separation, with the background component being 0 and with the foreground component being left intact. The eleventh to thirteenth pixels from left belonged to the covered background area before foreground/ background separation, with the background component being 0 and with the foreground component being left intact. The fifth to tenth pixels from left are left intact because these pixels are composed only of the background components.

Fig.54B shows an example of a background component picture corresponding to the frame #n of Fig.50. The leftmost pixel and the fourteenth pixel from left are composed only of the background component before foreground/ background separation, and hence are left intact.

The second to fourth pixels from left belonged to the uncovered background area before foreground/ background separation, with the foreground component being 0 and with the background component being left intact. The eleventh to thirteenth pixels from left belonged to the covered background area before foreground/background separation, with the background component being 0 and with the foreground component being left intact. The pixel values of the fifth to tenth pixels from left are set to zero because these pixels are composed only of the foreground components.

Referring to the flowchart of Fig.55, the processing for foreground/background separation by the foreground/background separating unit 105 is explained. At step S201, the frame memory 301 of the separating unit 251 acquires an input picture and stores the frame #n, to be processed for foreground/background separation, along with the previous frame #n-1 and the subsequent frame #n+1.

At step S202, the separating processing block 302 of the separating unit 251 acquires the area information supplied from the mixing ratio calculating unit 104. At step S203, the separating processing block 302 of the separating unit 251 acquires the mixing ratio α routed from the mixing ratio calculating unit 104.

At step S204, the uncovered area processor 311 extracts the background component, based on the area information and the mixing ratio α, the pixel values of pixels belonging to the uncovered background area, supplied from the frame memory 301.

At step S205, the uncovered area processor 311 extracts the foreground component, based on the area information and the mixing ratio α, the pixel values of pixels belonging to the uncovered background area, supplied from the frame memory 301.

At step S206, the covered area processor 312 extracts the background component, based on the area information and the mixing ratio α, the pixel values of pixels belonging to the covered background area, supplied from the frame memory 301.

At step S207, the covered area processor 312 extracts the foreground component, based on the area information and the mixing ratio α, the pixel values of pixels belonging to the covered background area, supplied from the frame memory 301.

At step S208, the synthesis unit 313 synthesizes the foreground component, belonging to the uncovered background area, extracted by the processing of step S205, and the foreground component, belonging to the covered background area, extracted by the processing of step S207. The synthesized foreground component is routed to the synthesis unit 253, which then synthesizes the pixels belonging to the foreground

area supplied via switch 252 and the foreground component supplied form the separating unit 251 to generate a foreground component picture.

At step S209, the synthesis unit 314 synthesizes the background component, belonging to the uncovered background area, extracted by the processing of step S204, and the background component, belonging to the covered background area, extracted by the processing of step S206. The synthesized foreground component is routed to the synthesis unit 255, which then synthesizes the pixels belonging to the foreground area supplied via switch 254 and the background component supplied form the separating unit 251 to generate a background component picture.

At step S210, the synthesis unit 253 outputs the foreground component picture. At step S211, the synthesis unit 255 outputs the background component picture to terminate the processing.

In this manner, the foreground/background separating unit 105 is able to separate the foreground component and the background component from the input picture, based on the area information and the mixing ratio α, to output a foreground component picture, made up only of the foreground components, and the background component picture, made up only of the background components.

The adjustment of the quantity of the motion blurring from the foreground component picture is explained.

In Fig.56, which is a block diagram showing an illustrative structure of the motion blurring adjustment unit 106, the motion vector supplied from the motion

detection unit 102, the corresponding position information and the area information supplied from the area specifying unit 103 are routed to a processing unit decision unit 351 and to a modelling unit 352. The foreground component picture supplied from the foreground/background separating unit 105 is sent to an addition unit 354.

The processing unit decision unit 351 routes the generated processing unit to the modelling unit 352, along with the motion vector, based on the motion vector, the corresponding position information and the area information.

The processing unit, generated by the processing unit decision unit 351, represents consecutive pixels, beginning from a pixel corresponding to the covered background area of the foreground component picture and extending up to a pixel corresponding to the uncovered background area, along the movement direction, or consecutive pixels, beginning from a pixel corresponding to the uncovered background area and extending up to a pixel corresponding to the covered background area, along the movement direction, as shown for example in Fig.57. The processing unit is made up e.g., of an upper left point and a lower right point. The upper left point is the position of a pixel specified by the processing unit and lying at the leftmost or uppermost point on a picture.

The modelling unit 352 executes the modelling based on the motion vector and on the input processing unit. More specifically, the modelling unit 352 may hold at the outset plural models corresponding to the number of pixels contained in the processing unit, the number of times of the virtual splitting of the pixel values in the

time axis direction and the number of the pixel-based foreground components to select a model specifying the correspondence between the pixel values and the foreground components, based on the processing unit and on the number of times of the virtual splitting of pixel values in the time axis direction, as shown in Fig.58.

For example, with the number of pixels corresponding to a processing unit being 12 and with the movement quantity v in the shutter time being 5, the modelling unit 352 selects a sum total of eight foreground components, with the leftmost pixel including one foreground component, the second left pixel including two foreground components, the third left pixel including three foreground components, the fourth left pixel including four foreground components, the second left pixel including two foreground components, the third left pixel including three foreground components, the fourth left pixel including four foreground components, the fifth left pixel including five foreground components, the sixth left pixel including five foreground components, the seventh left pixel including five foreground components, the eighth left pixel including five foreground components, the ninth left pixel including four foreground components, the tenth left pixel including three foreground components, the eleventh left pixel including two foreground components, and the twelfth left pixel including one foreground component.

Instead of selecting from the pre-stored model, the modelling unit 352 may generate the model based on the motion vector and on the processing unit, when the motion vector and the processing unit are supplied thereto.

The modelling unit 352 sends a selected model to an equation generating unit 353.

The equation generating unit 353 generates an equation based on the model supplied from the modelling unit 352. Referring to the model of the foreground component picture, shown in Fig.58, an equation generated by the equation generating unit 353 when the number of the foreground components is 8, the number of pixels corresponding to the processing unit is 12, the movement quantity v is 5, and the number of times of the virtual splitting is 5 is explained.

When the foreground components corresponding to the shutter time/v contained in the foreground component picture are F01/v to F08/v, the relation between the foreground components F01/v to F08/v and the pixel values C01 to C12 is represented by the equations (39) to (50):

$$C01 = F01/v \quad \cdots(39)$$

$$C02 = F02/v + F01/v \quad \cdots(40)$$

$$C03 = F03/v + F02/v + F01/v \quad \cdots(41)$$

$$C04 = F04/v + F03/v + F02/v + F01/v \quad \cdots(42)$$

$$C05 = F05/v + F04/v + F03/v + F02/v + F01/v$$

…(43)

C06 = F06/v + F05/v + F04/v + F03/v + F02/v

…(44)

C07 = F07/v + F06/v + F05/v + F04/v + F03/v

…(45)

C08 = F08/v + F07/v + F06/v + F05/v + F04/v

…(46)

C09 = F08/v + F07/v + F06/v + F05/v

…(47)

C10 = F08/v + F07/v + F06/v

…(48)

C11 = F08/v + F07/v

…(49)

C12 = F08/v

…(50)

The equation generating unit 353 modifies the generated equations to generate equations. The equations generated by the equation generating unit 353 are indicated by the equations (51) to (62):

C01 = 1·F01/v + 0·F02/v + 0·F03/v + 0·F04/v + 0·F05/v + 0·F06/v + 0·F07/v + 0·F08/v

…(51)

$$C02 = 1 \cdot F01/v + 1 \cdot F02/v + 0 \cdot F03/v + 0 \cdot F04/v + 0 \cdot F05/v + 0 \cdot F06/v + 0 \cdot F07/v + 0 \cdot F08/v \quad \cdots (52)$$

$$C03 = 1 \cdot F01/v + 1 \cdot F02/v + 1 \cdot F03/v + 0 \cdot F04/v + 0 \cdot F05/v + 0 \cdot F06/v + 0 \cdot F07/v + 0 \cdot F08/v \quad \cdots (53)$$

$$C04 = 1 \cdot F01/v + 1 \cdot F02/v + 1 \cdot F03/v + 1 \cdot F04/v + 0 \cdot F05/v + 0 \cdot F06/v + 0 \cdot F07/v + 0 \cdot F08/v \quad \cdots (54)$$

$$C05 = 1 \cdot F01/v + 1 \cdot F02/v + 1 \cdot F03/v + 1 \cdot F04/v + 1 \cdot F05/v + 0 \cdot F06/v + 0 \cdot F07/v + 0 \cdot F08/v \quad \cdots (55)$$

$$C06 = 0 \cdot F01/v + 1 \cdot F02/v + 1 \cdot F03/v + 1 \cdot F04/v + 1 \cdot F05/v + 1 \cdot F06/v + 0 \cdot F07/v + 0 \cdot F08/v \quad \cdots (56)$$

$$C07 = 0 \cdot F01/v + 0 \cdot F02/v + 1 \cdot F03/v + 1 \cdot F04/v + 1 \cdot F05/v + 1 \cdot F06/v + 1 \cdot F07/v + 0 \cdot F08/v \quad \cdots (57)$$

$$C08 = 0 \cdot F01/v + 0 \cdot F02/v + 0 \cdot F03/v + 1 \cdot F04/v + 1 \cdot F05/v + 0 \cdot F06/v + 1 \cdot F07/v + 1 \cdot F08/v \quad \cdots (58)$$

$$C09 = 0 \cdot F01/v + 0 \cdot F02/v + 0 \cdot F03/v + 0 \cdot F04/v + 1 \cdot F05/v + 1 \cdot F06/v + 1 \cdot F07/v + 1 \cdot F08/v \quad \cdots (59)$$

$$C10 = 0 \cdot F01/v + 0 \cdot F02/v + 0 \cdot F03/v + 0 \cdot F04/v + 0 \cdot F05/v + 1 \cdot F06/v + 1 \cdot F07/v + 1 \cdot F08/v \quad \cdots (60)$$

$$C11 = 0 \cdot F01/v + 0 \cdot F02/v + 0 \cdot F03/v + 0 \cdot F04/v + 0 \cdot F05/v + 0 \cdot F06/v + 0 \cdot F07/v + 1 \cdot F08/v \quad \cdots (61)$$

$$C12 = 0 \cdot F01/v + 0 \cdot F02/v + 0 \cdot F03/v + 1 \cdot F04/v + 1 \cdot F05/v + 0 \cdot F06/v + 1 \cdot F07/v + 1 \cdot F08/v \quad \cdots (62)$$

The equations (51) to (62) may also be represented by the equation (63):

$$Cj = \sum_{i=01}^{08} \alpha ij \cdot Fi / v \quad \cdots (63)$$

where j indicates the pixel position. In this case, j assumes one of values of 1 to 12. On the other hand, i denotes the position of the foreground value, and assumes one of values of 1 to 8. Aij has values of 0 or 1 in association with the values of i and j.

If an error is taken into account, the equation (63) may be represented by the equation (64):

$$Cj = \sum_{i=01}^{08} aij \cdot Fi / v + ej \qquad \cdots (64)$$

where ej is an error contained in a considered pixel C_j.

The equation (64) may be rewritten to the equation (65):

$$ej = Cj - \sum_{i=01}^{08} \alpha ij \cdot Fi / v \qquad \cdots (65).$$

In order to apply the least square sum, a square sum of errors E is defined as indicated by the equation (66):

$$E = \sum_{j=01}^{12} ej^2 \qquad \cdots (66).$$

In order to minimize the error, it suffices if the value of the partial differentiation by a variable FK with respect to the error square sum E is 0. Fk is found to satisfy the equation (67):

$$\begin{aligned} \frac{\delta E}{\delta Fk} &= 2 \cdot \sum_{i=01}^{12} ej \cdot \frac{\delta ej}{\delta Fk} \\ &= 2 \cdot \sum_{j=01}^{12} \{(Cj - \sum_{i=01}^{08} aij \cdot Fi / v) \cdot (-akj / v) = 0 \end{aligned} \qquad \cdots (67).$$

Since the movement quantity v in the equation (67) is constant, the equation (68):

$$\sum_{j=01}^{12} akj \cdot (Cj - \sum_{i=01}^{08} aij \cdot Fi / v) = 0 \qquad \cdots (68)$$

can be derived.

Developing the equation (68) and shifting the term, we obtain the equation (69):

$$\sum_{j=01}^{12}(akj \cdot \sum_{i=01}^{08} aij \cdot Fi) = v \cdot \sum_{j=01}^{12} akj \cdot Cj \qquad \cdots (69).$$

The equation (69) is expanded into eight equations by substituting one of integers of 1 to 8. The resulting eight equations can be represented by matrix by a sole equation termed a normal equation.

An example of the normal equation, generated by the equation generating unit 353 based on the minimum square method, is the following equation (70):

$$\begin{bmatrix} 54321000 \\ 45432100 \\ 34543210 \\ 23454321 \\ 12345432 \\ 01234543 \\ 00123454 \\ 00012345 \end{bmatrix} \begin{bmatrix} F01 \\ F02 \\ F03 \\ F04 \\ F05 \\ F06 \\ F07 \\ F08 \end{bmatrix} = v \cdot \begin{bmatrix} \sum_{i=08}^{12} Ci \\ \sum_{i=07}^{11} Ci \\ \sum_{i=06}^{10} Ci \\ \sum_{i=05}^{09} Ci \\ \sum_{i=04}^{08} Ci \\ \sum_{i=03}^{07} Ci \\ \sum_{i=02}^{06} Ci \\ \sum_{i=01}^{05} Ci \end{bmatrix} \qquad \cdots (70).$$

If the equation (70) is expressed as A·F = v·C, C, A and v are known, while F is unknown. On the other hand, A and v are known at the modelling stage, C becomes

known on inputting a pixel value in the adding operation.

By calculating the foreground component by the normal equation which is based on the least square method, it is possible to effect scattering of errors contained in the pixel C.

The equation generating unit 353 sends the so-generated normal equation to an addition unit 354.

Based on the processing unit, supplied from the processing unit decision unit 351, the addition unit 354 sets the pixel value C, contained in the foreground component picture, in the matrix equation supplied from the equation generating unit 353. The addition unit 354 sends the matrix, having set the pixel value C set therein, to an operating unit 355.

The operating unit 355 calculates the foreground component freed of motion blurring Fi/v, by the processing which is based on the solution method, such as Gauss·JordAn erasure method, to find Fi corresponding to one of integers 0 to 8 of i as pixel values of the foreground freed of the motion blurring to output the foreground component picture composed of pixel values freed of motion blurring Fi to a motion blurring adding unit 356 and to a selection unit 357.

Meanwhile, F01 to F08 are set to C03 to C10, in the foreground component picture freed of the motion blurring, shown in Fig.59, in order to produce no changes in the position of the foreground component picture relative to the picture screen. An arbitrary position can be set.

The motion blurring adding unit 356 is able to adjust the quantity of the motion blurring by imparting the motion blurring adjustment quantity v' different from the movement quantity v, for example, the motion blurring adjustment quantity v' equal to one-half the movement quantity v, or the motion blurring adjustment quantity v' irrelevant to the movement quantity v, to adjust the value of the motion blurring quantity. For example, the motion blurring adding unit 356 divides the pixel value Fi of the foreground freed of the motion blurring by the motion blurring adjustment value v' to calculate the foreground component Fi/v' and sums the foreground components Fi/v' to generate a pixel value adjusted for the motion blurring quantity, as shown in Fig.60. For example, if the motion blurring adjustment quantity v' is 3, the pixel value C02 is (F01/v'), the pixel value C03 is (F01 + F02)/v', the pixel value C04 is (F01 + F02 + F03)/v' and the pixel value C05 is (F02 + F03 + F04)/v'.

The motion blurring adding unit 356 sends the foreground component picture, adjusted for the motion blurring quantity, to the selection unit 357.

Based on the selection signal corresponding to the user's selection, the selection unit 357 selects one of the foreground component picture freed of the motion blurring, sent from the operating unit 355 and the foreground component picture from the motion blurring adding unit 356 adjusted for the motion blurring quantity to output the selected foreground component picture.

The motion blurring adjustment unit 106 thus is able to adjust the motion blurring quantity based on the selection signals and the motion blurring adjustment

quantity v'.

For example, if the number of pixels associated with the selection signal is eight and the movement quantity v is four, as shown in Fig.61, the motion blurring adjustment unit 106 is able to generate the matrix equation (71):

$$\begin{bmatrix} 43210 \\ 34321 \\ 23432 \\ 12343 \\ 01234 \end{bmatrix} \begin{bmatrix} F01 \\ F02 \\ F03 \\ F04 \\ F05 \end{bmatrix} = v \cdot \begin{bmatrix} \sum_{i=05}^{08} Ci \\ \sum_{i=04}^{07} Ci \\ \sum_{i=03}^{06} Ci \\ \sum_{i=02}^{05} Ci \\ \sum_{i=01}^{04} Ci \end{bmatrix} \quad \cdots (71).$$

The motion blurring adjustment unit 106 thus establishes a number of equations corresponding to the length of the processing unit to calculate the pixel value Fi adjusted for the motion blurring quantity. In similar manner, if the number of pixels contained in a processing unit is 100, the motion blurring adjustment unit 106 generates 100 equations in association with the 100 pixels to calculate Fi.

In Fig.62, showing another configuration of the motion blurring adjustment unit 106, the parts or components similar to those shown in Fig.56 are indicated by the same reference numerals and are not explained specifically.

A selection unit 361 routes the input motion vector and the corresponding position signal directly to the processing unit decision unit 351 and to the modelling

unit 352. Alternatively, the selection unit 361 substitutes the motion blurring adjustment quantity v' for the magnitude of the motion vector to route the motion vector, the magnitude ofhas been replaced by the motion blurring adjustment quantity v' and the corresponding position signal directly to the processing unit decision unit 351 and to the modelling unit 352.

By so doing, the processing unit decision units 351 to 355 of the motion blurring adjustment unit 106 of Fig.62 are able to adjust the motion blurring quantity in association with the movement quantity v and with the motion blurring adjustment quantity v'. For example, if the movement quantity v is 5 and the motion blurring adjustment quantity v' is 3, the processing unit decision units 351 to 355 of the motion blurring adjustment unit 106 of Fig.62 executes the processing on the foreground component picture, with the movement quantity v of Fig.58 equal to 5, in accordance with the model shown in Fig.60 corresponding to the motion blurring adjustment quantity v' equal to 3, to calculate a picture containing the motion blurring corresponding to the movement quantity v of (movement quantity v)/ (motion blurring adjustment quantity v') = 5/3, that is approximately 1.7. Since the calculated picture is free of the motion blurring corresponding to the movement quantity v equal to 3, attention is to be directed to the fact that the relation between the movement quantity v and the motion blurring adjustment quantity v' has a different meaning from the results of the motion blurring adding unit 356.

The motion blurring adjustment unit 106 generates an equation in association

with the movement quantity v and the processing unit and sets the pixel values of the foreground component picture in the generated equation to calculate the foreground component picture adjusted for the motion blurring quantity.

Referring to the flowchart of Fig.63, the processing for adjusting the motion blurring quantity in the foreground component picture by the motion blurring adjustment unit 106 is explained.

At step S251, the processing unit decision unit 351 of the motion blurring adjustment unit 106 generates a processing unit, based on the motion vector and the area information, to send the generated processing unit to the modelling unit 352.

At step S252, the modelling unit 352 of the motion blurring adjustment unit 106 selects and generates a model in association with the movement quantity v and the processing unit. At step S253, the equation generating unit 353 generates the normal equation, based on the selected model.

At step S254, the addition unit 354 sets pixel values of the foreground component picture in the so-generated normal equation. At step S255, the addition unit 354 verifies whether or not the pixel values of the totality of pixels of the processing unit have been set. If it is verified that the pixel values of the totality of pixels corresponding to the processing unit have not been set, the program reverts to step S254 to repeat the processing of setting pixel values in the normal equation.

If it is decided at step S255 that the pixel values of the totality of pixels corresponding to the processing unit have been set, the program reverts to step S256

where the operating unit 355 calculates the pixel values of the foreground, adjusted for the motion blurring quantity, based on the normal equation from the addition unit 354, in which the pixel values have been set, to terminate the processing.

In this manner, the motion blurring adjustment unit 106 is able to adjust the motion blurring quantity based on the motion vector and the area information, from the foreground component picture containing the motion blurring.

That is, the motion blurring adjustment unit 106 is able to adjust the motion blurring quantity in the pixel values as sampling data.

Meanwhile, the structure of the motion blurring adjustment unit 106, shown in Fig.56, is merely exemplary and is not intended to limit the present invention.

The signal processor 12, the configuration of which is shown in Fig.10, is able to adjust the quantity of the motion blurring contained in the input picture. The signal processor 12, the configuration of which is shown in Fig.10, is able to calculate the mixing ratio α as the buried information to output the so-calculated mixing ratio α.

Fig.64 is a block diagram showing a modified configuration of the functions of the signal processor 12.

The parts or components similar to those of Fig.10 are indicated by the same reference numerals and are not explained specifically.

The area specifying unit 103 sends the area information to the mixing ratio calculating unit 104 and to the synthesis unit 371.

The mixing ratio calculating unit 104 sends the area information to the

foreground/background separating unit 105 and to the synthesis unit 371.

The foreground/background separating unit 105 sends the foreground component picture to the synthesis unit 371.

Based on the mixing ratio α supplied from the mixing ratio calculating unit 104 and on the area information supplied from the area specifying unit 103, the synthesis unit 371 synthesizes an optional background picture and the foreground component picture supplied from the foreground/background separating unit 105 to output a picture synthesized from the optional background picture and the foreground component picture.

Fig.65 shows the configuration of the synthesis unit 371. A background component generating unit 381 generates a background component picture, based on the mixing ratio α and on an optional background picture, to route the so-generated background component picture to a mixed area picture synthesis unit 382.

The mixed area picture synthesis unit 382 synthesizes the background component picture supplied from the supplied from the background component generating unit 381 and the foreground component picture to generate a mixed area synthesized picture which is routed to a picture synthesis unit 383.

Based on the area information, the picture synthesis unit 383 synthesizes the foreground component picture, mixed area synthesized picture supplied from the mixed area picture synthesis unit 382 and an optional background picture to generate and output a synthesized picture.

In this manner, the synthesis unit 371 is able to synthesize the foreground component picture to an optional background picture.

The picture obtained on synthesis of a foreground component picture with an optional background picture, based on the mixing ratio α, as a characteristic value, is more spontaneous than a picture obtained on simply synthesizing the pixels.

Fig.66 shows, in a block diagram, a further configuration of the function of the signal processor 12 adapted for adjusting the motion blurring quantity. The signal processor 12 shown in Fig.10 calculates the mixing ratio α and specifies the area sequentially, whereas the signal processor 12 shown in Fig.66 specifies the area and calculates the mixing ratio α by parallel processing.

The functions similar to those shown in the block diagram of Fig.10 are denoted by the same reference numerals and are not explained specifically.

The input picture is sent to a mixing ratio calculating unit 401, foreground/background separating unit 402, an area specifying unit 103 and to an object extraction unit 101.

Based on the input picture, the mixing ratio calculating unit 401 calculates, for each of the pixels contained in the input picture, the estimated mixing ratio in case the pixel is assumed to belong to the covered background area, and the estimated mixing ratio in case the pixel is assumed to belong to the uncovered background area, to supply the so-calculated estimated mixing ratio in case the pixel is assumed to belong to the covered background area and estimated mixing ratio in case the pixel is assumed

to belong to the uncovered background area, to the foreground/background separating unit 402.

Fig.67 shows, in a block diagram an illustrative structure of the mixing ratio calculating unit 401.

The estimated mixing ratio processor 201, shown in Fig.67, is similar to the estimated mixing ratio processor 201 shown in Fig.37. The estimated mixing ratio processing unit 202, shown in Fig.67, is the same as the estimated mixing ratio processing unit 202 shown in Fig.37.

The estimated mixing ratio processor 201 calculates the estimated mixing ratio, from pixel to pixel, by calculations corresponding to the model of the covered background area, based on the input picture, to output the so-calculated estimated mixing ratio.

The estimated mixing ratio processor 202 calculates the estimated mixing ratio, from pixel to pixel, by calculations corresponding to the model of the uncovered background area, based on the input picture, to output the so-calculated estimated mixing ratio.

Based on the estimated mixing ratio in case the pixel is assumed to belong to the covered background area, and the estimated mixing ratio in case the pixel is assumed to belong to the uncovered background area, supplied from the mixing ratio calculating unit 401, and on the area information, supplied from the area specifying unit 103, the foreground/background separating unit 402 generates a foreground

component picture from the input picture, to route the so-generated foreground component picture to the motion blurring adjustment unit 106 and to the selection unit 107.

Fig.68 is a block diagram showing an illustrative structure of the foreground/background separating unit 402.

The parts or components similar to those of the foreground/background separating unit 105 shown in Fig.48 are indicated by the same reference numerals and not explained specifically.

Based on the area information supplied from the area specifying unit 103, a selection unit 421 selects one of the estimated mixing ratio in case the pixel is assumed to belong to the covered background area, and the estimated mixing ratio in case the pixel is assumed to belong to the uncovered background area, supplied from the mixing ratio calculating unit 401, and routes the so-selected estimated mixing ratio as the mixing ratio α to the separating unit 251.

Based on the mixing ratio α and the area information, supplied from the selection unit 421, the separating unit 251 separates the foreground components and the background components from the pixel values of pixels belonging to the mixed area, to send the foreground components extracted to the synthesis unit 253, as well as to send the background components to the synthesis unit 255.

The separating unit 251 may be configured similarly to the structure shown in Fig.53.

The synthesis unit 253 synthesizes and outputs the foreground component picture. The synthesis unit 255 synthesizes and outputs the background component picture.

The motion blurring adjustment unit 106, shown in Fig.66, may be configured as in Fig.10. Based on the area information and the motion vector, the motion blurring adjustment unit 106 adjusts the quantity of the motion blurring supplied from the foreground/background separating unit 402, to output the foreground component picture adjusted for the motion blurring quantity.

Based on the selection signal, corresponding to the selection by the user, the selection unit 107 selects one of the foreground component picture supplied from the foreground/background separating unit 402 and the foreground component picture from the motion blurring adjustment unit 106, adjusted for the motion blurring quantity, to output the selected foreground component picture.

In this manner, the signal processor 12, the configuration of which is shown in Fig.66, is able to adjust a picture, corresponding to an object of the foreground object contained in the input picture, to output the resulting picture. The signal processor 12, the configuration of which is shown in Fig.66, is able to calculate the mixing ratio α, as the buried information, as in the first embodiment, to output the so-calculated mixing ratio α.

Fig.69 is a block diagram showing a modification of the function of the signal processor 12 adapted for synthesizing the foreground component picture to an optional

background picture. The signal processor 12, shown in Fig.64, performs area identification and the calculation of the mixing ratio α in series, whereas the signal processor 12, shown in Fig.69, performs area identification and the calculation of the mixing ratio α in parallel.

The functions similar to those shown in the block diagram of Fig.66 are denoted by the same reference numerals and are not explained specifically.

Based on the input picture, the mixing ratio calculating unit 401, shown in Fig.69, calculates the estimated mixing ratio for when the pixel is assumed to belong to the covered background area and the estimated mixing ratio for when the pixel is assumed to belong to the uncovered background area, for each of the pixels contained in the input picture, to route the estimated mixing ratio for when the pixel is assumed to belong to the covered background area and the estimated mixing ratio for when the pixel is assumed to belong to the uncovered background area, to the foreground/background separating unit 402 and to the synthesis unit 431.

Based on the estimated mixing ratio for when the pixel is assumed to belong to the covered background area, the estimated mixing ratio for when the pixel is assumed to belong to the uncovered background area, supplied from the mixing ratio calculating unit 401, and on the area information supplied from the area specifying unit 103, the foreground/background separating unit 402, shown in Fig.69, generates the foreground component picture from the input picture to route the generated foreground component picture to the synthesis unit 431.

Based on the estimated mixing ratio for when the pixel is assumed to belong to the covered background area, the estimated mixing ratio for when the pixel is assumed to belong to the uncovered background area, supplied from the mixing ratio calculating unit 401, and on the area information supplied from the area specifying unit 103, the synthesis unit 431 synthesizes an optional background area and a foreground component picture supplied from the foreground/background separating unit 402, to output a picture synthesized from the optional background area and the foreground component picture.

Fig.70 shows the configuration of the synthesis unit 431. The functions similar to those shown in the block diagram of Fig.65 are denoted by the same reference numerals and are not explained specifically.

Based on the area information, supplied from the area specifying unit 103, a selection unit 441 selects one of the estimated mixing ratio for when the pixel is assumed to belong to the covered background area and the estimated mixing ratio for when the pixel is assumed to belong to the uncovered background area, supplied from the mixing ratio calculating unit 401, to route the selected estimated mixing ratio as the mixing ratio α to the background component generating unit 381.

Based on the mixing ratio α supplied from the selection unit 441 and the optional background component picture, the background component generating unit 381, shown in Fig.70, generates a background component picture, to route the generated picture to the mixed area picture synthesis unit 382.

The mixed area picture synthesis unit 382, shown in Fig.70, synthesizes the background component picture, supplied from the background component generating unit 381, to the foreground component picture, to generate a mixed area synthesized picture, which is routed to the picture synthesis unit 383.

Based on the area information, the picture synthesis unit 383 synthesizes foreground component picture, the mixed area synthesized picture, supplied from the mixed area picture synthesis unit 382 and an optional background picture, to generate and output a synthesized picture.

In this manner, the synthesis unit 431 is able to synthesize the foreground component picture to an optional background picture.

Although the mixing ratio α has been explained as a proportion of the background component contained in the pixel value, it may also be a proportion of the foreground component contained in the pixel value.

Although the direction of movement of the object as the foreground has been explained as being from left to right, this direction is, of course, not limitative.

An embodiment in which the amount of the motion blurring quantity contained in temperature or pressure data by the similar processing as that performed by the signal processor 12 is explained.

Fig.71 shows an illustrative structure of a signal processing apparatus according to the present invention. A thermography device 451 detects IR rays, radiated from an object being measured from an enclosed IR sensor, such as an IR CCD, to generate a

signal corresponding to the wavelength or intensity of the detected IR rays. The thermography device 451 analog/digital converts the generated signal to compare the converted signal to reference data corresponding to the reference temperature to generate temperature data indicating the temperature of various sites of the object to output the generated temperature data to the signal processor 452.

Similarly to the sensor 11, the thermography device 451 has integrating effects with respect to the space and time.

The temperature data the thermography device 451 routes to the signal processor 452 is configured similarly to the picture data of the moving picture, and is such data in which the values indicating the temperature of respective sites of the object being measured (corresponding to the pixel values of the picture data) are arrayed two-dimensionally along the spatial direction in association with the picture data frames and also are arrayed along the temporal direction.

The signal processor 452 adjusts the distortion contained in the input temperature data and which has been generated as a result of movement of the object being measured. For example, the signal processor 452 extracts a more accurate temperature of the desired site of the object being measured.

Fig.72 is a flowchart showing the processing for adjusting the motion blurring quantity by the signal processor 452. At step S301, the signal processor 452 acquires temperature data in which values indicating the temperatures for respective sites of the object being measured are arrayed two-dimensionally. Based on the temperature data,

the signal processor 452 generates data specifying the movement.

At step S302, the signal processor 452 specifies areas of temperature data to a foreground area comprising only the values indicating the temperature corresponding to a desired object, a background area comprising only the values indicating the temperature corresponding to an object other than the desired object, and a mixed area comprising the temperature information corresponding to the desired object and the temperature information corresponding to the object other than the desired object.

At step S303, the signal processor 452 checks whether or not the temperature indicating value belongs to the temperature data. If the signal processor 452 decides that the temperature indicating value belongs to the mixed area, the signal processor 452 proceeds to step S304 to calculate the mixing ratio α by the processing similar to that of step S102 of Fig.27.

At step S305, the signal processor 452 separates the information of the temperature corresponding to the object desiring temperature measurement, by the processing similar to the processing of step S103 of Fig.27, to then proceed to step S306.

For separating the temperature information at step S305, the temperature information may be converted, based on the Kirchhoff's law or the law specifying the relation between the object temperature and the radiated IR rays, such as Stephen-Boltzmann law, into the energy quantity of the IR rays, emitted from the object desiring temperature measurement, to separate the energy quantity of the converted

IR rays to re-convert the separated energy quantity into temperature. By conversion into the IR ray energy prior to separation, the signal processor 452 is able to separate the temperature information more accurately than in direct separation of the temperature information.

If, at step S303, the temperature indicating value contained in the temperature data does not belong to the mixed area, it is unnecessary to separate the temperature information corresponding to the object desiring the temperature measurement. So, the processing at steps S304 and S305 are skipped so that the processing proceeds to step S306.

At step S306, the signal processor 452 generates temperature data for causing temperature measurement to correspond to the desired object, from a value indicating the temperature belonging to the foreground temperature and the information on the temperature which causes the temperature measurement to correspond to the desired object.

At step S307, the signal processor 452 generates a model corresponding to the generated temperature data by the processing similar to the processing at step S251.

At step S308, the signal processor 452 adjusts the quantity of the motion blurring contained in the temperature data corresponding to the object, in need of temperature measurement, by the processing similar to that of steps S252 to S255 of Fig.63, based on the generated model, to terminate the processing.

In this manner, the signal processor 452 adjusts the quantity of the motion

blurring contained in the temperature data generated by the movement of the object being measured to calculate the more accurate temperature difference of respective object portions.

Fig.73 shows an illustrative structure of a signal processing apparatus according to the present invention for weighing measurement. The pressure area sensor 501 is made up of plural pressure sensors to measure the load per unit planar area, that is the pressure. . The pressure area sensor 501 is of a structure comprised of a two-dimensional array on a floor surface of plural pressure sensors 511-1-1 to 511-M-N. When an object 512, the weight of which is being measured, is moved on the pressure area sensor 501, the pressure area sensor 501 measures the pressure applied to each of the pressure sensors 511-1-1 to 511-M-N to generate weight data for each of measured ranges of the pressure sensors 511-1-1 to 511-M-N to output the generated weight data to the signal processor 502.

The pressure sensors 511-1-1 to 511-M-N are each made up of a sensor exploiting double refraction produced when an external force is applied to a transparent elastic material, or the so-called photoelasticity.

The pressure area sensor 501 in its entirety may be constructed by a sensor exploiting the photoelasticity.

Fig.75 illustrates the load associated with the weight of each part of the object 512 applied to respective ones of the pressure sensors 511-1-1 to 511-M-N making up the pressure area sensor 501.

The load A corresponding to the weight of the leftmost portion of the object 512 in Fig.75 is applied to the pressure sensor 511-m-1. The load b corresponding to the weight of the second left portion of the object 512 is applied to the pressure sensor 511-m-2. The load c corresponding to the weight of the fourth left portion of the object 512 is applied to the pressure sensor 511-m-3. The load d corresponding to the weight of the fourth left portion of the object 512 is applied to the pressure sensor 511-m-4.

The load e corresponding to the weight of the second left portion of the object 512 is applied to the pressure sensor 511-m-5. The load f corresponding to the weight of the fourth left portion of the object 512 is applied to the pressure sensor 511-m-6. The load g corresponding to the weight of the fourth left portion of the object 512 is applied to the pressure sensor 511-m-7.

The weight data output by the pressure area sensor 501 corresponds to the arrangement of the pressure sensor 511-1-1 to 511-M-N and is comprised of weight values arrayed two-dimensionally in the spatial direction.

Fig.76 illustrates typical weight data output by the pressure area sensor 501 when the object 512 is moving, with the pressure area sensor 501 having integrating effects.

On the pressure sensor 511-m-1 is applied a load A corresponding to the weight of the leftmost portion of the object 512 in a unit time of measurement, a value A is output as a value indicating the weight included in the weight data.

In the unit time for measurement, there are applied to the pressure sensor 511-m-2 a load b corresponding to the weight of the second left portion of the object 512, and a load d corresponding to the weight of the leftmost portion of the object 512,so the pressure sensor 511-m-2 outputs a value A+b as a value indicating the weight comprehended in the weight data.

In the unit time for measurement, there are applied to the pressure sensor 511-m-3 a load c corresponding to the weight of the third left portion of the object 512, a load b corresponding to the weight of the second left portion of the object 512 and subsequently the load A corresponding to the weight of the second left portion of the object 512, so the pressure sensor 511-m-2 outputs a value A+b+c as a value indicating the weight comprehended in the weight data.

In the unit time for measurement, there are applied to the pressure sensor 511-m-4 a load d corresponding to the weight of the fourth left portion of the object 512, a load c corresponding to the weight of the third left portion of the object 512, a load b corresponding to the weight of the second left portion of the object 512 and subsequently the load A corresponding to the weight of the leftmost portion of the object 512, so the pressure sensor 511-m-2 outputs a value A+b+c+d as a value indicating the weight comprehended in the weight data.

In the unit time for measurement, there are applied to the pressure sensor 511-m-5 a load e corresponding to the weight of the fifth left portion of the object 512, a load d corresponding to the weight of the fourth left portion of the object 512, a load

c corresponding to the weight of the third left portion of the object 512 and subsequently the load A corresponding to the weight of the second left portion of the object 512, so the pressure sensor 511-m-5 outputs a value b+c+d+e as a value indicating the weight comprehended in the weight data.

In the unit time for measurement, there are applied to the pressure sensor 511-m-6 a load f corresponding to the weight of the sixth left portion of the object 512, a load e corresponding to the weight of the fifth left portion of the object 512, a load d corresponding to the weight of the fourth left portion of the object 512 and subsequently the load c corresponding to the weight of the third left portion of the object 512, so the pressure sensor 511-m-6 outputs a value c+d+e+f as a value indicating the weight comprehended in the weight data.

In the unit time for measurement, there are applied to the pressure sensor 511-m-7 a load g corresponding to the weight of the seventh left portion of the object 512, a load f corresponding to the weight of the sixth left portion of the object 512, a load e corresponding to the weight of the fifth left portion of the object 512 and subsequently the load d corresponding to the weight of the fourth left portion of the object 512, so the pressure sensor 511-m-7 outputs a value d+e+f+g as a value indicating the weight comprehended in the weight data.

In the unit time for measurement, there are applied to the pressure sensor 511-m-8 a load g corresponding to the weight of the seventh left portion of the object 512, a load f corresponding to the weight of the sixth left portion of the object 512, and a

load e corresponding to the weight of the fifth left portion of the object 512, so the pressure sensor 511-m-8 outputs a value e+f+g as a value indicating the weight comprehended in the weight data.

In the unit time for measurement, there are applied to the pressure sensor 511-m-9 a load g corresponding to the weight of the seventh left portion of the object 512, and a load f corresponding to the weight of the sixth left portion of the object 512, so the pressure sensor 511-m-9 outputs a value f+g as a value indicating the weight comprehended in the weight data.

In the unit time for measurement, there is applied to the pressure sensor 511-m-10 a load g corresponding to the weight of the seventh left portion of the object 512, so the pressure sensor 511-m-10 outputs a value g as a value indicating the weight comprehended in the weight data.

The pressure area sensor 501 outputs weight data comprised of the value A output by the pressure sensor 511-m-1, the value A+b output by the pressure sensor 511-m-2, the value A+b+c output by the pressure sensor 511-m-3, the value A+b+c+d output by the pressure sensor 511-m-4, the value b+c+d+e output by the pressure sensor 511-m-4, the value A+b+c output by the pressure sensor 511-m-3, the value A+b+c+d output by the pressure sensor 511-m-4, the value b+c+d+e output by the pressure sensor 511-m-5, the value c+d+e+f output by the pressure sensor 511-m-6, the value d+e+f+g output by the pressure sensor 511-m-7, the value e+f+g output by the pressure sensor 511-m-8, the value f+g output by the pressure sensor 511-m-9,

and the value g output by the pressure sensor 511-m-10.

The signal processor 502 adjusts the distortion generated by the movement of the object 512 being measured from the weight data supplied from the pressure area sensor 501. For example, the signal processor 502 extracts more accurate weight of the desired sites of the object 512 being measured. For example, the signal processor 502 extracts the loads A and b to g from weight data comprised of the value A, A+b, A+b+c, A+b+c+d, b+c+d+e, c+d+e+f, d+e+f+g, e+f+g, f+g and g.

Referring to the flowchart of Fig.77, the processing for calculating the load executed by the signal processor 502 is explained.

At step S401, the signal processor 502 acquires weight data output by the pressure area sensor 501. At step S402, the signal processor 502 decides, based on the weight data acquired from the pressure area sensor 501, whether or not the load of the object 512 is being applied to the pressure area sensor 501. If it is decided that the load of the object 512 is being applied to the pressure area sensor 501, the signal processor 502 proceeds to step S403 to acquire the movement of the object 512 based on changes in the weight data.

At step S404, the signal processor 502 acquires one-line data of the pressure sensor 511 contained in the weight data along the direction of movement acquired by the processing at step S403.

At step S405, the signal processor 502 calculates the load corresponding to the weight of the respective portions o the object 512 to terminate the processing. The

signal processor 502 calculates the load corresponding to the weights of respective parts of the object 512 by a processing similar to the processing explained with reference to the flowchart of Fig.63.

If, at step S402, the load of the object 512 is not applied to the pressure area sensor 501, there is no weight data to be processed, so the processing is terminated.

In this manner, the weight measurement system is able to calculate the correct load corresponding to the weight of each portion of the moving object.

The signal processor 12 generating a picture of higher resolution in the spatial direction is explained.

Fig.78 is a block diagram showing a configuration of generating high resolution picture by increasing the number of pixels per frame, as another function of the signal processor 12.

A frame memory 701 stores an input picture on the frame basis and sends the stored picture to a pixel value generator 702 and to a correlation calculating unit 703.

The correlation calculating unit 703 calculates the correlation values of pixel values neighboring to one another in a transverse direction, contained in a picture supplied from the frame memory 701, to send the calculated correlation values to the pixel value generator 702. The pixel value generator 702 calculates double density picture components from the pixel values of the center pixel, based on the correlation values supplied from the correlation calculating unit 703, to generate a horizontal double-density picture, with the so-calculated picture component as the pixel value.

The pixel value generator 702 sends the so-generated horizontal double-density picture to the frame memory 704.

The frame memory 704 stores the horizontal double-density picture, supplied from the pixel value generator 702, to send the so-stored horizontal double-density picture to a pixel value generating unit 705 and to a correlation calculating unit 706.

The correlation calculating unit 706 calculates the correlation values of pixel values neighboring to one another in a vertical direction, contained in a picture supplied from the frame memory 704, to send the calculated correlation values to the pixel value generator 705. The pixel value generator 705 calculates double density picture components from the pixel values of the center pixel, based on the correlation values supplied from the correlation calculating unit 703, to generate a horizontal double-density picture, with the so-calculated picture component as the pixel value. The pixel value generator 705 outputs the so-generated horizontal double-density picture.

The processing for generating a horizontal double-density picture by the pixel value generator 702 is explained.

Fig.79 shows an arrangement of pixels provided in a sensor 11 as a CCD, and an area for pixel data of a horizontal double-density picture. In Fig.79, A to I indicate individual pixels. The areas A to r each denote a light reception area obtained on halving the individual pixels A to I in the longitudinal direction. With the width 2l of the light reception area of each of the pixels A to I, the width of each of the areas A

to r is I. The pixel value generator 702 calculates the pixel values of the pixel data associated with the areas A to r.

Fig.80 illustrates pixel data corresponding to the light incident on the areas A to r. In Fig.80, f'(x) denotes an spatially ideal pixel value in association with the input light and to the spatially tiny domain.

If a pixel value of a pixel data is represented by the uniform integration of the ideal pixel value f'(x), the pixel value Y1 of pixel data associated with the area i is represented by the equation (72):

$$Y1 = f(x)dx \cdot \frac{1}{e} \qquad \cdots(72)$$

whilst the pixel value Y2 of the picture data associated with the area j and the pixel value Y3 of the pixel E are represented by the following equations (73) and (74):

$$Y2 = \int_{x2}^{x3} f(x)dx \cdot \frac{1}{e} \qquad \cdots (73)$$

and

$$\begin{aligned} Y3 &= \int_{x1}^{x3} f(x)dx \cdot \frac{1}{2e} \\ &= \frac{Y1 + Y2}{2} \end{aligned} \qquad \cdots (74)$$

respectively.

In the above equations (72) to (74), x1, x2 and x3 are spatial coordinates of the respective boundaries of the light reception area, area i and the area j of the pixel E,

respectively.

By modifying the equation (74), the following equations (75), (76) may be derived:

$$Y1 = 2 \cdot Y3 \cdot Y2 \qquad \cdots(75)$$

and

$$Y2 = 2 \cdot Y3 \cdot Y1 \qquad \cdots(76).$$

Therefore, if the pixel value Y3 of the pixel E and the pixel value Y2 of the pixel data corresponding to the area j are known, the pixel value Y1 of the pixel data corresponding to the area i may be calculated from the equation (75). Also, if the pixel value Y3 of the pixel E and the pixel value Y1 of the pixel data corresponding to the area i are known, the pixel value Y2 of the pixel data corresponding to the area j can be calculated from the area j.

If the pixel value corresponding to a pixel and one of pixel values of the pixel data corresponding to the two areas of the pixel are known, the pixel value of the other pixel data corresponding to the other areas of the pixel may be calculated.

Referring to Fig.81, the manner of calculating the pixel values of the pixel data corresponding to the two areas of one pixel is explained. Fig.81A shows the relation between the pixels D, E and F and the spatially ideal pixel value f'(x).

Since the pixels D to F own integrating effects, and one pixel outputs a pixel